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MODULATION THE PERFORMANCE OF JAPANESE QUAIL CHICKS EXPOSED TO ACUTE HEAT STRESS BY USING DIFFERENT MEANS

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Abstract

Three experiments were performed to assess the effects of exposure to acute heat stress (A.H.S.) (40ºC) on the performance of Japanese quail chicks from one day old to six weeks of age. In all experiments, birds raised in heated batteries under continuous lighting, free feeding and water regimes. All experiments were started at one-day old and ended at six weeks of age. The results indicated that body weight (B.W.) was significantly decreased in 4 hr's-heat stressed (H.S.) group at 3, 4 and 5 wks of age. The highest B.W. was found in Ascorbic acids (A.A.) (500 mg) fed group. Feed intake decreased in H.S. 2 and 4 hr's and H.S.+fasting groups. Water consumption and mortality increased as HS period increased.

These results suggest that AA addition to feed could ameliorate the negative effects of A.H.S. in Japanese quail.

Key Words: Heat stress, Japanese quail, Ascorbic acid (A.A.), Kcl, and fasting.

INTRODUCTION

As birds accumulate heat in their tissues, several responses to increase the dissipation of heat are invoked to reduce the heat load voluntary. Feed consumption is diminished in response to high environmental temperature (Quart, *et al.*, 1989). Short term withdrawal can lower bird's body temperature and increase its ability to survive acute heat stress. Teeter, *et al.* (1987) studied the influence of fasting duration on broiler gain and survival. They showed that fasting intervals beginning 3-6h prior to heat stress initiation and totalling up to 12 hours daily during significant heat stress (up to 37ºC) reduce mortality significantly. Ambient temperature is the major factor affecting water intake (Austic, 1985). Ahmad, *et al.* (1967) showed that ascorbic acid limited the increase of body temperature during heat stress up to 35°C. Under conditions of high environmental temperatures some mammals and birds are not able to synthesize sufficent ascorbic acid to replace the severe losses of this vitamin that occur suring stress. Supplemental ascorbic acid has also been reported to improve heat resistance and reduce mortality associated with elevated ambient temperature (Pardue, *et al.*, 1984). It has been known for some time that k requirement of growing chickens increases with increased temperature. Huston (1978) observed that blood k concentrations were reduced in growing chickens by high environmental temperature. Teeter, et al. (1987) concluded that dietary k levels should be increased for birds reared in heat-stressed environments.

The present study aimed to ameliorate the negative effects of acute heat stress in Japanese quail by different means.

MATERIALS AND METHODS

Experiment I

This experiment was performed at El-Fayoum Poultary Research Farm to study and compare the effects of acute heat stress (AHS) on the performance of Japanese quail. A total of 135 one-day old unsexed quail chicks were randomly distributed into three groups of 45 chicks each. The experiment was continued until six weeks of age. At two, four and six weeks of age, birds of the first, second and third groups, were exposed to 40°C-H S for zero (control), two (2h-HS) and four (4h-HS) hours, respectively. Birds were fed a commercial starter mash diet containing 24% C.P., 2900 kcal M.E./kg and 3.2% crude fiber according to the requirements of Japanese quail of NRC (1994) from one day old up to six weeks of age. Birds had a continuous access to feed and water unless mentioned to another way. Birds were raised in batteries under continuous lighting conditions.

Some productive parameters such as body weight (B.W), weight gain (W.G), feed intake (F.I), water consumption (W.C), feed conversion (F.C), and mortality rate (M.R) were determined weekly from the first to the sixth week of age. Water/feed ratio was also calculated.

Experiment II

This experiment aimed to study, whether or not fasting (feed deprivation) before and/or during exposure of acute heat stress could ameliorate the dramatic effects of heat stress on the performance of Japanese quail chicks. A total of 135 one-day old unsexed Japanese quail chicks was randomly distributed into three groups of 45 chicks each. At two, four and six weeks of age, birds received 4 hr's of 40°C-H S with no fasting (4h-HS+0h-F), 4 hr's of 40°C-HS with fasting (4h-HS+4h-F)(no access to feed during HS period), and 4 hr's-fasting then 4 hr's of 40°C-H S with fasting (4h-HS+8h-F)(no access to feed before and during H S period) for the second, third and fourth groups, respectively. Because experiments I and II were performed at the same time, the control group in experiment I was considered as a nagative control for experiment II, while, the second group in experiment II was considered as a positive control. The same productive parameters determined in experiment I, were measured again at this experiment.

Experiment III

This experiment was performed to assess the role of feeding different levels of ascorbic acid (AA) or potassium chloride (Kcl) in alleviating the deleterious effects of AHS on the performance of Japanese quail chicks during the growth period.

Two hundreds and seventy one-day old unsexed quail chicks were randomly distributed into six groups of 45 birds each. The first group (a negative control) had no treatment, while, the second group (a positive control) received 4 hr's of 40°C-HS and fed the regular starter mash diet. Birds of the third and fourth groups were fed a starter mash diet mixed with 1.5 and 2% Kcl, respectively. A starter mash diet mixed well with 250 and 500 AA mg/kg was offered to the fifth and sixth groups, respectively. All groups were fed the regular diet during the first week of age, and the experimental diets were offered from two up to six weeks of age. All groups except the first one (control) received 4 hr's of 40°C-HS at two, four and six weeks of age.

Statistical analysis was performed on main frame SAS using an analysis of variance (ANOVA) or general linear model (GLM) procedures (SAS. 1994).

Mean values of body weight and weight gain were statistically analyzed according to the following model:

$$Y_{ij} = \mu + T_i + e_{ij}$$

where: Y: represents a variable.

μ: represents the overall mean.

T: represents the treatment effect.

e_{ij}: represents the error effect.

Means were separated by applying a paired t-test or Duncan's Multiple Range Test. Comparisons with a P value less than or equal 0.05 were considered significant.

RESULTS AND DISCUSSION

The results of body weights, weight gain, feed intake, feed conversion, water consumption, water/feed ratio and mortility rate from hatch till 6 wks of age as affected by AA, kcl levels and fasting under heat stress are summarized in Tables 1-5.

1. Body Weight and Weight Gain

Body weight (B.W)of Japanese quail exposed to A.H.S is presented in Table 1. In experiment I, heat-stressed groups (2 and 4 hr's) had significantly ($P \leq 0.05$) higher B.W than control at the third and fourth weeks of age. The highest B.W was recorded for 2h-HS group at three, five and six weeks of age, although, the differences in B.W between this group and other groups were insignificant. In experiment II, birds subjected to 4h-F during 4h-HS had significantly ($P=0.05$) lower B.W at the third and fourth weeks of age, while, those received 8h-F before and during 4h-HS had significantly ($P=0.05$) higher B.W at five and six weeks of age.

In experiment III, quails fed AA and exposed to A.H.S had significantly ($P=0.05$) higher B.W at the third up to the sixth week of age, particularly 500 mg AA-fed group that recorded the highest B.W as compared with control group and all other experimental groups. Feeding Kcl with 4h-HS resulted in a significant ($P=0.05$) increase in B.W only at six weeks of age. It is clear that, exposure to 4h-HS resulted in an insignificant decrease in B.W of Japanese quail at the end of experimental period. These results suggested that, AA supplementation, particularly at 500 mg level ameliorated the negative influence of A.H.S on the B.W of Japanese quail and improved their B.W up to six weeks of age.

The influence of A.H.S on weight gain (W.G) of Japanese quail from one to six weeks of age is presented in Table 2. In experiment I, 2h-HS treatment did not affect the W.G at all ages, while, 4h-HS treatment decreased W.G at the fifth and sixth weeks of age. Birds receiving 8h-F with 4h-HS gained more weight than those received 4h-F with 4h-HS at the third up to the sixth week of age. In experiment III, birds offered AA-diet achieved significantly ($P=0.05$) higher W.G than that of control and 4h-HS

Table 1. Body weight of japanese quail from one to six weeks of age[1].

Trt	Age (week) 1		2		3		4		5		6	
						Exp. I						
CON	25.6±0.62^{a,3}	37[2]	57.3±1.51^{a}	37	96.1±1.54^{a}	32	136.2±2.01^{a}	32	167.7±2.67^{a}	32	197.2±4.54^{a}	23
2h-H.S	27.2±0.65^{a}	43	61.1±1.30^{b}	42	110.0±1.65^{b}	31	141.6±5.22^{ab}	30	172.7±7.28^{a}	30	201.5±7.96^{a}	30
4h-H.S	27.2±0.57^{a}	43	56.9±10.0^{a}	43	104.1±1.49^{c}	32	146.9±2.29^{b}	32	167.7±2.90^{a}	32	190.8±4.23^{a}	32
						Exp. II						
4h-H.S-+0h-F	27.5±0.65^{a}	44	58.9±1.16^{a}	43	101.2±1.13^{a}	32	142.8±2.09^{a}	32	166.2±2.69^{a}	32	190.8±3.76^{a}	32
4h-H.S-+4h-F	27.1±0.46^{a}	45	56.4±0.94^{a}	45	88.8±2.03^{b}	37	130.3±2.72^{b}	35	163.8±3.08^{a}	34	187.0±4.48^{a}	34
4h-H.S-+8h-F	27.5±0.59^{a}	46	56.3±1.22^{a}	46	98.6±1.51^{a}	33	140.9±1.72^{a}	33	178.0±3.01^{a}	33	206.8±4.90^{b}	33
						Exp. III						
CON	92.1±0.55^{a}	43	59.7±1.19^{a}	42	92.7±2.11^{a}	38	129.7±2.25^{a}	38	168.9±2.60^{ab}	38	191.6±2.98^{a}	38
4h-H.S+0-KCL/AA	29.0±0.53^{a}	45	61.3±1.12^{a}	45	95.8±1.43^{a}	38	132.2±1.95^{a}	36	164.2±2.53^{b}	36	186.4±3.34^{a}	36
4h-H.S+1.5% KCL	29.5±0.60^{a}	44	61.5±1.25^{a}	43	96.4±1.86^{a}	37	132.4±2.28^{a}	36	166.9±2.52^{ab}	36	200.6±3.13^{b}	36
4h-H.S+2.0% KCL	28.8±0.53^{a}	43	61.4±1.12^{a}	43	95.9±1.53^{a}	39	129.3±1.71^{a}	37	175.0±2.29^{ac}	36	205.1±2.83^{b}	36
4h-H.S+250 mg AA	28.8±0.58^{a}	44	60.9±1.15^{a}	43	94.6±2.56^{a}	40	140.5±1.41^{b}	38	180.2±1.63^{cd}	38	215.1±2.38^{c}	38
4h-H.S+500-KCL/AA	29.6±0.46^{a}	43	61.1±0.99^{a}	43	104.3±1.23^{b}	39	148.1±1.83^{c}	39	187.1±5.48^{d}	39	225.4±3.67^{d}	39

[1] Data expressed as g/bird/week:X±S.E.M.

[2] n = as mentioned for each age and treatment.

[3] Means with different superscripts (a, b, c, d) for each age and experiment are significant different ($P \leq 0.05$).

Table 2. Body weight of japanese quail from one to six weeks of age[1].

Trt	Age (week)											
	0 - 1	n	1 - 2	n	2 - 3	n	3 - 4	n	4 - 5	n	5 - 6	n
	Exp. I											
CON	$19.2\pm0.59^{a,3}$	37[2]	31.6±1.20ab	37	37.5 ± 1.09^{a}	32	40.1 ± 1.00^{ab}	32	31.6 ± 1.47^{a}	32	29.5 ± 2.50^{a}	23
2h-H.S	21.0 ± 0.62^{a}	43	33.5±0.88a	42	45.7 ± 1.06^{b}	31	37.2 ± 0.98^{b}	30	36.1 ± 1.41^{b}	30	26.7 ± 2.07^{a}	30
4h-H.S	20.8 ± 0.52^{a}	43	29.7±0.73b	43	44.4 ± 0.78^{b}	32	42.8 ± 1.25^{a}	32	20.8 ± 1.15^{c}	32	32.1 ± 2.01^{a}	32
	Exp. II											
4h-H.S-+0h-F	21.4 ± 0.61^{a}	44	31.4±0.89a	43	38.8 ± 0.94^{a}	32	41.6 ± 1.28^{a}	32	23.4 ± 1.14^{a}	32	24.5 ± 1.51^{a}	32
4h-H.S-+4h-F	20.9 ± 0.47^{a}	45	29.3±0.66a	45	30.2 ± 1.41^{b}	37	40.7 ± 1.52^{a}	35	33.2 ± 1.44^{b}	34	24.5 ± 2.19^{a}	34
4h-H.S-+8h-F	21.4 ± 0.57^{a}	46	28.8±0.94a	46	40.5 ± 0.79^{a}	33	42.3 ± 0.68^{a}	33	37.1 ± 1.80^{b}	33	28.8 ± 2.13^{a}	33
	Exp. III											
CON	22.7 ± 0.67^{a}	43	30.6±0.85a	42	33.6 ± 1.34^{a}	38	37.0 ± 1.10^{a}	38	39.2 ± 1.04^{ab}	38	22.7 ± 1.10^{a}	38
4h-H.S+0-KCL/AA	23.1±0.46	45	32.3±0.78a	45	34.3 ± 1.11^{a}	38	36.6 ± 0.99^{bc}	36	32.0 ± 1.12^{b}	36	22.2 ± 1.24^{c}	36
4h-H.S+1.5% KCL	23.6 ± 0.48^{a}	44	31.9±0.71a	43	34.2 ± 1.06^{a}	37	36.0 ± 1.03^{bc}	36	34.5 ± 1.10^{b}	36	33.7 ± 1.41^{ab}	36
4h-H.S+2.0% KCL	22.9 ± 0.43^{a}	43	32.9±0.75a	43	34.6 ± 1.18^{a}	39	32.8 ± 0.95^{a}	37	44.8 ± 1.26^{a}	36	30.1 ± 1.05^{b}	36
4h-H.S+250 mg AA	23.9 ± 0.36^{a}	44	31.6±0.66a	43	42.6 ± 0.84^{b}	40	43.8 ± 1.04^{a}	38	39.0 ± 5.40^{ab}	38	38.3 ± 4.74^{ab}	38
4h-H.S+500-KCL/AA	23.2 ± 0.48^{a}	43	32.2±0.68a	43	33.6 ± 2.53^{a}	39	46.4 ± 2.41^{a}	39	39.7 ± 0.31^{ab}	39	34.9 ± 1.45^{a}	39

[1] Data expressed as g/bird/week:X±S.E.M.

[2] n = as mentioned for each age and treatment.

[3] Means with different superscripts (a, b, c, d) for each age and experiment are significant different ($P\leq0.05$).

groups at four up to six weeks of age and than that of Kcl-fed group, particularly at four and six weeks of age.

These results indicated that, adding AA to the diet of Japanese quail ameliorated the dramatic effect of A.H.S on the W.G more than fasting or Kcl feeding. This increase in body weight after exposure to heat stress early in life could be attributed to the compensation of weight loss during heat exposure.

These results are in agreement with those obtained by Yahav and Hurwitz (1996) who observed an accelerated growth in the group exposed once to high environmental temperature which resulted in complete compensation for the loss of growth as early as four weeks of age. These results suggested that, under hot environment, it may be of advantage to expose chicks during their first week of life to high temperature.

In experiment II, birds received 4h-H.S with 4h-fasting had significantly (P=0.05) lower body weight at 3 and 4 weeks of age. The reduction in body weight of heat-treated groups with fasting may be due to that birds did not achieve complete compensation. Another possible explanation for the reduction in body weight of heated and fasted groups is due to the continuous panting which results in the severity of blood alkalosis which cause lowered feed intake and thereby, growth rate. During the panting process, blood gasses also become altered as a result of the rapid elimination of carbon dioxide and this may have an impact on the movement of minerals ions within the body. These factors have a deleterious effect on both growth and survival (Smith, 1993).

In experiment III, addition of ascorbic acid (AA) to the diet of heat-stressed birds resulted in a significant increase in body weight at 3 up to 6 weeks of age. This increase in body weight of birds exposed to heat stress and fed AA-diet had more than possible explanation. The quantities of ascorbic acid synthesized in the kidney may have been inadequate during the hot period, hence, dietary supplementation tended to increase growth. Another explanation of the improvement in the growth of chicks fed AA during heat stress is due to immaturity of the endogenous AA enzyme systems, as many enzyme systems in neonates function suboptimally. Therefore, AA supplementation provides sufficient AA for metabolism (Pardue *et al.*, 1985).

Ascorbic acid could reduce the synthesis of glucocorticoids during heat stress (Thaxton and Pardue, 1984). The results of Galal (1999) support this explanation, where plasma corticosterone levels were significantly higher for AA-unsupplemented than for AA - supplemented heat stressed quails. Thus, AA supplementation during heat stress could be beneficial for growing chicks, as heat - induced increases in corticosteroids may cause increased degradation of tissue proteins (Frankel, 1970).

2. Feed Intake and Feed Conversion

Feed intake (F.I) of Japanese quail from one up to six weeks of age is presented in Table 3. In experiment I, birds exposed to acute heat stress (2h and 4h) almost consumed the same amount of feed like control group. In experiment II, birds exposed to 4h-F with 4h-HS consumed less amount of feed than the other two groups at all ages except the first and sixth week of age, where, the opposite trend appeared Table 3).

In experiment III, the same trend was noticed between the control and all experimental groups at all ages as reported in experiment I, except 1.5% Kcl-fed group that consumed more feed than all other groups at six weeks of age. Feed conversion ratio (F.C)of quails exposed to A.H.S was higher than control at the fifth and sixth weeks of age, but, it was almost like control at one up to four weeks of age (Table 3). In experiment II, 4h-HS+8h-F treatment improved F.C starting at three up to six weeks of age and 4h-HS+4H-F treatment had the same trend, except at six weeks of age where F.C changed to be higher than the negative and positive control groups. In experiment III, birds fed AA-diet and exposed to A.H.S had lower F.C than those of control and other experimental groups at four, five and six weeks of age. These results indicated that, AA supplementation (500 mg/kg diet) improved F.C of Japanese quail exposed to A.H.S more than 1.5 and 2% Kcl feeding or 8h-fasting. The reduction in feed consumption is delayed until several hours after the birds have experienced high temperatures, while, water consumption increases immediately.

3. Water Consumption and Water/Feed Ratio

Water consumption (W.C) and water/feed ratio (W/F) of Japanese quail from one to six weeks of age are presented in Table 4. Birds exposed to A.H.S (2 and 4h) drank more amount of water than control at all ages except one week old. The increasing amount of W.C represented about 12 and 24% for 2h- and 4h-HS, respectively. Regardless H.S, W.C increased as age increased.

Table 3. Feed intake (F.I)[1] and feed conversion ratio (F.C)[2] of Japanese quail from one to six weeks of age.

Trt	Periods (week)											
	0-1		1-2		2-3		3-4		4-5		5-6	
	F.I	F.C	F.I	F.C	F.I	F.C	F.I	F.C	F.I	F.C	F.I	F.C
Exp. I												
CON	4.6	1.68	7.1	1.63	11.9	2.2	13.6	2.38	15	3.31	20	4.75
2h-H.S	4.2	1.41	7.9	1.65	13.2	2.02	12.9	2.46	17.7	3.43	21.3	5.49
4h-H.S	4.3	1.44	7.3	1.72	11.3	1.79	13.6	2.22	15.6	5.24	21.7	6.57
Exp. II												
4h-H.S-+0h-F	4.8	1.55	7.7	1.7	12.3	2.32	14.9	2.5	15	4.49	18.5	5.19
4h-H.S-+4h-F	4.8	1.61	7.1	1.69	10.4	2.34	13	2.28	14.3	3.02	19.9	5.68
4h-H.S-+8h-F	4.6	1.55	7.2	1.78	11.6	2.02	14.1	2.35	17.2	3.25	18.9	4.59
Exp. III												
CON	4.7	1.44	8.3	1.9	10.4	2.18	14.9	2.82	17.5	3.12	18.4	5.67
4h-H.S+0-KCL/AA	4.4	1.34	8.5	1.85	11.4	2.32	18	3.44	18.9	4.13	21	6.91
4h-H.S+1.5% KCL	4.3	1.26	7.7	1.68	8.7	1.44	14.7	2.86	17.2	3.5	24.3	5.07
4h-H.S+2.0% KCL	4.1	1.27	8.9	1.92	9.3	1.87	14.8	3.1	18.3	2.86	21	4.89
4h-H.S+250 mg AA	4.1	1.22	7.7	1.68	9.2	1.81	14.9	2.37	17.7	3.12	21.2	4.25
4h-H.S+500-KCL/AA	4.5	1.32	7.3	1.63	10.3	1.69	14.7	2.35	17.7	2.77	20.2	4.16

[1] Data expressed as feed intake (g/bird/day).
[2] Data expressed as ratio of feed intake/weight gain.

Table 4. Water consumption (W.C)[1] and water:feed ratio (W/F)[2] of Japanese quail from one to six weeks of age.

Trt	Periods (week)											
	0 - 1		1 - 2		2 - 3		3 - 4		4 - 5		5 - 6	
	W.C	W/F	W.C	W/F	W.C	W/F	W.C	W/F	W.C	W/F	W.C	W/F
	Exp. I											
CON	16.8	3.65	24.6	3.47	34.8	2.92	38.2	2.81	41.1	2.74	44.6	2.33
2h-H.S	15.1	3.6	27.8	3.52	38.9	2.95	42.7	3.31	46.1	2.6	50.8	2.38
4h-H.S	15.5	3.61	28.8	3.95	36.3	3.21	48.3	3.55	43.2	2.77	55.4	2.55
	Exp. II											
4h-H.S-+0h-F	17.2	3.58	29	3.77	36.8	2.99	46.8	3.14	42.4	2.83	47.8	2.58
4h-H.S-+4h-F	17.3	3.6	28.2	3.97	33.8	3.25	45.2	3.48	40	2.8	51.5	2.59
4h-H.S-+8h-F	16.8	3.65	28.4	3.94	34.1	2.94	40.7	2.89	44.7	2.6	46.5	2.46
	Exp. III											
CON	17.2	3.66	28	3.37	33.6	3.23	36.9	2.48	40.3	2.3	43.7	2.38
4h-H.S+0-KCL/AA	16	3.64	30.2	3.55	38.5	3.38	47.6	2.64	45.3	2.4	55.3	2.63
4h-H.S+1.5% KCL	15.9	3.7	29.7	3.86	33.9	3.9	40.4	2.75	44.7	2.6	58.2	2.4
4h-H.S+2.0% KCL	15.1	3.68	31.6	3.55	40.2	4.32	53	3.58	58.5	3.2	62.6	2.98
4h-H.S+250 mg AA	15.2	3.7	26.2	3.4	31.4	3.41	40.4	2.71	42.2	2.38	47.6	2.25
4h-H.S+500-KCL/AA	16.1	3.58	26.4	3.62	31.4	3.05	35.4	2.41	39.9	2.25	45.3	2.24

1 Data expressed as water consumption (ml/bird/day).

2 Data expressed as ratio of water consumption/feed intake.

Irrespective of H.S, W/F had the opposite trend of W.C but W/F of H.S-treated birds had the same trend of W.C of H.S-treated birds. In experiment II, W.C of 4h-HS+8h-F treated group was slightly increased as compared with control, although it was less than that of 4h-HS treated group. W/F of this treatment had the same trend.

In experiment III, W.C of 2% Kcl-fed birds was higher than that of 4h-HS treated birds and AA-fed group at three up to six weeks of age and the greatest differences were at four, five and six weeks of age. W/F had the same trend. These results suggested that AA supplementation alleviated the elevation of W.C which is the most dramatic effect of A.H.S. to be like W.C of control group.

During exposure to heat stress, chicks consumed less feed and more water to compensate for water lost through evaporative cooling from respiratory surfaces. Another reason for increasing the amount of water consumption is the increasing of urine output during exposure to thermal stress (Belay *et al.*, 1992).

4. Mortality Rate

Mortality rate (MR) of Japanese quail exposed to acute heat stress (40°C for four hours at two, four and six weeks of age) alone, acute heat stress with fasting and acute heat stress with adding certain levels of potassium chloride or ascorbic acid to the diet are illustrated in Table 5. In the first experiment, MR increased as the HS-period was increased where birds exposed to 4h-HS had the highest heat-stressed MR (13.3%). It is obvious from the results of second experiment that eight-hours fasting (4 hr's before and 4 hr's during HS) reduced MR more than four hours fasting only during heat stress period (50% versus 33%). In experiment III, it is clear that dietary supplementing of 2% kcl resulted in 50% reduction in MR versus 25% for adding 1.5% kcl. The high mortality during heat exposure could be attributed to the reduction in potassium level in plasma (Galal, 1999). Birds fed 250 or 500 mg AA had the same MR like control group. It was noticed that, most of mortalities as a result of exposure to acute HS occurred at two weeks of age. The present results suggested that the deleterious effect of A.H.S on MR of Japanese quail was at early age, and dietary-AA supplementation ameliorated MR of heat-stressed birds more than other tested means.

Table 5. Mortality rate (MR) of Japanese quail from one to six weeks of age.

Treatments	Initial number	Total number	H.S-Mortal number[1]	Total MR[2] %	H.S-MR[3] %
			Exp. I		
CON	45	11	0	24.4	0
2h-H.S	45	8	1	17.8	2.2
4h-H.S	45	11	6	24.4	13.3
			Exp. II		
4h-H.S-+0h-F	45	11	6	24.4	13.3
4h-H.S-+4h-F	45	10	4	22.2	8.9
4h-H.S-+8h-F	45	9	3	20	6.7
			Exp. III		
CON	45	4	0	8.9	0
4h-H.S+0-KCL/AA	45	6	4	13.3	8.9
4h-H.S+1.5% KCL	45	6	3	13.3	6.7
4h-H.S+2.0% KCL	45	6	2	13.3	4.5
4h-H.S+250 mg AA	45	5	0	11.1	0
4h-H.S+500-KCL/AA	45	3	1	6.7	2.2

[1] Mortal number of birds during heat stress periods.
[2] Mortality rate expressed as a percentage of (total mortal number/initial number).
[3] Mortality rate expressed as a percentage of (mortal number during heat stress/initial number).

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معالجة الإجهاد الحرارى الحاد على أداء كتاكيت السمان اليابانى بطرق مختلفة

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أشتملت هذه الدراسة على ثلاث تجارب. اعتبرت التجربة الاولى كتجربة تمهيدية لدراسة تأثير الاجهاد الحرارى لفترات قصيرة (ساعتين واربع ساعات على درجة ٤٠°م) على اداء طائر السمان خلال فترة التسمين من حيث بعض المقاييس الانتاجية. وقد استخدم فى هذه التجربة عدد ١٣٥ طائر سمان غير مجنس عمر يوم.

وقد صممت التجربة الثانية والثالثة بناء على نتائج التجربة الاولى وقد استخدم عدد ١٨٠ و ٢٧٠ طائراً سمان عمر يوم غير مجنس فى كل من التجربة الثانية والثالثة على الترتيب. وكان الهدف من اجراء تلك التجارب هو اختبار اى من طرق المعاملة المتبعة (طريقة التصويم لمدة اربعة او ثمانية ساعات او اضافة كلوريد البوتاسيوم بنسبة ١,٥ و ٢٪ فى العليقة او اضافة فيتامين ج بمعدل ٢٥٠و ٥٠٠ ملليجرام لكل كيلو جرام عليقه) تقلل من التأثيرات السلبية للحرارة البيئية المرتفعة على الأداء اثناء فترة النمو.

بدأت جميع التجارب عند عمر يوم واحد وانتهت عند ستة اسابيع من العمر وفى كل التجارب ربيت الطيور فى بطاريات وتحت نظام اضاءة مستمرة وغذاء وماء متاح فيما عدا التجربة الثانية التى كانت معاملتها تشتمل على عدد ساعات تصويم للطيور. وكانت العليقة المغذاه تحتوى على ٢٤٪ بروتين خام و ٢٩٠٠ كيلو كالورى طاقة ممثلة و ٣,٢٪ الياف خام.

وكانت النتائج الاساسيه المتحصل عليها من هذه الدراسة هى:

١- انخفض وزن الجسم معنويا فى المجموعة المعرضه لاربع ساعات على ٤٠×م مقارنة بالمجموعة المعرضة لساعتين وكذلك مجموعة المقارنة عند ثلاثة واربعة وخمسة اسابيع من العمر بينما كان وزن الجسم للطيور التى تم تصويمها لمدة ٨ ساعات أعلى معنويا مقارنة بالمجموعة الغير معاملة عند خمسة وستة اسابيع من العمر. وكان وزن الجسم للمجموعة المغذاه على مستويات مختلفة من حامض الاسكوربيك اعلى معنويا عند عمر ٣ حتى ٦ اسابيع وكان اعلى وزن جسم فى المجموعة المغذاه على ٥٠٠ ملجم حامض الاسكوربيك عند عمر ٦ اسابيع.

٢- ارتفاع معدل الزيادة الوزنية معنويا للمجموعة المعرضه للاجهاد الحرارى لمدة ٤ ساعات عند ٣ اسايبع من العمر بينما انخفضت معنويا عند عمر ٥ ، ٦ اسابيع. وارتفعت الزيادة الوزنية

معنويا فى المجموعة المضاف كلوريد البوتاسيوم الى عليقتها (١,٥ ، ٢٪) عند ٥، ٦ اسابيع من العمر. كما ارتفعت الزيادة الوزنية معنويا فى المجموعة المغذاة على حامض الاسكوربيك عند ٤، ٦ اسابيع من العمر.

٣- كان الاستهلاك الغذائى أعلى فى المجموعة المعرضة للإجهاد الحرارى (٢ ساعة) فى التجربة الأولى, بينما كان أقل فى المجموعة المعرضة للإجهاد الحرارى لمدة ٤ ساعات مع التصويم لمدة ٤ ساعات فى التجربة الثانية. وكان أعلى للمجموعة المعرضة للإجهاد الحرارى ومغذاه على كلوريد البوتاسيوم ١,٥٪ عند الأسبوع السادس فى التجربة الثالثة.

٤- ارتفعت نسبة تحويل الغذاء فى المجموعتين المعرضتين للاجهاد الحرارى عند ٥، ٦ اسابيع من العمر وفى نهاية الفترة التجريبية للتجربة الاولى. ولكن فى التجربة الثانية تحسنت نسبة التحويل الغذائى فى المجموعة التى تم تصويمها لمدة ٨ ساعات عند عمر حتى ٦ اسابيع. وفى التجربة الثالثة كانت اعلى نسبة تحويل غذائى فى المجموعة المعرضة للاجهاد الحرارى لمدة ٤ ساعات بينما كانت اقل نسبة تحويل غذائى فى المجموعة المغذاة على ٥٠٠ ملجم حامض اسكوربيك وذلك طوال الفترة التجريبية.

٥- إزداد استهلاك المياة فى الطيور المعرضة للاجهاد الحرارى زيادة طردية وكانت هذة الزيادة طفيفة فى المجموعتين اللتين تم تصويمهما. بينما إزداد استهلاك المياة بدرجة كبيرة وملحوظة فى المجموعتين اللتين تم تغذيتهما على عليقة تحتوى على كلوريد البوتاسيوم. لم تلاحظ أية فروق فى كمية المياة المستهلكة بين المجموعتين اللتين تم تغذيتهما على عليقة مضاف اليها حامض الاسكوربيك.

٦- إزدادت نسبة استهلاك المياة الى الغذاء وسجلت نفس الفروق بين المجاميع كما فى حالة استهلاك المياه.

٧- إزدادت نسبة النفوق الراجعة الى الاجهاد الحرارى بزيادة مدة التعريض للاجهاد الحرارى. وقد ادى نظام التصويم والتغذية على علائق محتوية على كلوريد البوتاسيوم او حامض الاسكوربيك الى انخفاض معدل النفوق الراجع الى الاجهاد الحرارى وكان اقل معدل نفوق فى المجموعتين اللتين تم تغذيتهما على علائق حامض الاسكوربيك.